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On the use of seismic tomography to optimally constrain the thermal evolution of oceanic lithosphere

Bruno Goutorbe (1) and John Hillier (2)

(1) Instituto de Geociências, Universidade Federal Fluminense, Niterói, Brazil (goutorbe@hotmail.com), (2) Department of Geography, Loughborough University, Leicestershire, UK (J.Hillier@lboro.ac.uk)

Upper mantle velocities derived from surface wave tomography are increasingly used to constrain the thermal structure of the continental mantle. Recent works showed that they can be consistently integrated with other observations to better capture the thermal evolution of oceanic lithosphere. Within the theory of plate tectonics, the oceanic lithosphere is created at high temperature on mid-oceanic ridges, then cools by conduction and subsides by thermal contraction as it moves away from the ridge. The models which approximate its thermal evolution are traditionally adjusted on two classes of observations: surface heat flow and ocean depths. These constrain the surface derivative and the integral over depth of the temperature field, respectively. A third class of constraints may be derived from upper mantle velocities, which can potentially provide a direct image of the lithospheric temperature field rather than indirect quantities derived from it. The integration of seismically derived temperatures with heat flow and bathymetry opens the possibility of setting up an inverse problem completely independent from the models, which are simply particular solutions of the heat equation, thereby providing fundamental insights on the processes of lithosphere-asthenosphere interaction.